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ABSTRACT

The purpose of this paper is to provide an overview of the history, development, and services of the packet switching network services that currently exist in the United States. The character of packet switching, a computerized method of transmitting data, is used as the basis for tracing the development of the industry itself. Contending that the packet switching industry can only be clearly perceived as the combination of the major firms that provide the service, the paper focuses on the major providers of these services: Telenet and Tymnet. The future of the industry and the entrance of such new vendors of packet switching as Boeing Computer Services and American Bell are also considered. Predicting that the major thrust in this field will be in embedding more processing features such as electronic mail, the paper argues that it is the value added features that the networks can support that must be the area of greatest potential growth. (DMC)

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Packet Switching Networks:

An introduction with some attention to selected vendors

By

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Packet Switching Network Services:

An introduction with some attention to selected vendors

The purpose of this paper is to provide an overview of the history, development and services of the packet switching network services that currently exist in the United States. The character of packet switching itself will be discussed as a basis for tracing the development of the industry itself. The packet switching industry can only be clearly perceived as the combination of the major firms that provide the service, and so the discussion will be focused on the major providers of these services, both presently and historically: Telenet and Tymnet. Finally, the paper will consider the future of the industry and broaden its perspective to include such new vendors of packet switching as Boeing Computer Services and American Bell.*

What is packet switching?

Packet switching is a method of transmitting data. The data is broken into small units called packets. The packet sizes that are current vary in size: Telenet and Net 1000 utilized packet sizes of

*Such derivative vendors such as IBM will not be considered inasmuch as the "marketeers" in the industry do not pioneer technology and in packet switching the advantage lies with dedicated design. For a general perspective on IBM's technology practice, not specifically about their open secret (Nov 1983) packet switching service, see Feigenbaum and McCorduck, The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World. Reading, Mass.: Addison Wesley, March 1983. pp.177-179 and 179-183.

128 characters and Tymnet packets includes 66 characters.*

These packets are then mixed with other packets to form a single high baud stream of data transmissions. At the destination node, the packets of a message are sifted out of the stream and reassembled for reception at the designated access point.

The value of this scheme is obvious. Packetizing data and multiplexing the transmission of data from from many sources (which can include single point and LAN real time data acquisition) can dramatically reduce the costs of data transmission by optimizing the utilization of channel capacity. It is upon this basis that packet switching as an industry is based. But of course, being a real industry in a real world, the development of the technology has followed a more complex path than one might have supposed.

Development of the Packet Switching Industry: Telenet and Tymshare

The origins of the these two firms reflect a very different approach to the provision of packet switching services initially. While the technology of the two systems has tended to converge over time, the origins continue to reflect in the present configuration of their

*using specially designed equipment, Telenet and Tymnet packetize data at the access point the the networks; Net 1000 using VAX frontends at service nodes. This allows for the possibility of errors creeping into transmitted data since there can considerable distances between access points and service nodes. Johnson, J. "T-Net twins tested", Datamation, April 1983, p.140.

networks today.

Tymnet, a wholly owed subsidiary of Tymshare, is a logical outgrowth of the original business objective of Tymshare, namely providing time-sharing access to computer processing. As the complexity of the task of providing connections between access points and computers increased, the network service itself became a major element of Tymshare's business. Accordingly, in 1969 Tymnet was set up to process networking for Tymshare. The system was designed to allow a central computing center to allocate channel resources to its Varian micro-computer switches.*

In contrast, Telenet Communications Corporation was a product of research on ARPANET** networking problems. Established in 1972, and introducing its services in 1975, Telenet was built around the concept of dynamic allocation techniques for packet switching. This technique allows for a decentralized routing procedure in which each packet may follow a separate path to its destination. At the same time that this technique enhances the optimization of channel capacity allocation, dynamic allocation's decentralization evades the queuing

*Ibid, pp. 144-145.

** ARPANET is the first major packet switching network. Developed by by the ARPA (Advanced Research Project Agency) of DOD, the system would ultimately include more than 300 computers in North America and Western Europe until being partitioned in 1983. This segmentation of of the system would attempt to reduce the ease of unauthorized entry into the system by children since it is ostensibly a secure system, although its reliance on Telenet and Tymshare services make it no more secure than the commercial systems themselves. For a short discussion of ARPANET history and response to numerous penetrations by

bottleneck that results with the Tymnet central allocation configuration. Telenet chose Prime minicomputers functioning as network switches.*

Thus it can be seen that the design of the two networks is quite completely a result of the original business purposes of the systems. The technical issues of resource allocation have pushed each of the systems closer together in terms of systems configuration. Each system now uses specially designed equipment to packetize its data (instead of off-the-shelf minis) and Tymnet has started decentralizing allocation tasks. In this last point, Tymnet has attempted both to overcome problems of central location allocation's task magnitude as well as to improve its ability to respond to transient, local opportunities to enhance allocation efficiency.

*Johnson, J, op.cit, pp.145-146.

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children, see "Security cited as DOD splits ARPANET in two" Computerworld, October 10, 1983, p.74. For general statements of the problem posed to packet switching networks (whose optimally transparent quality is a boon to the penetration of systems) see Pollack, A. "Electronic trespassers", New York Times, Nov 10, 1983 and Beeler, J. "Hacking", and Keefe, P. "Several public nets dismiss hacker problem", both Computerworld, Sept 12, 1983, pp. 1,8 and 13 respectively. For a more general discussion of network security and lack thereof, see Bamford, J. The Puzzle Palace: Inside the National Security Agency. New York: Penguin, 1982. pp.420-421, 473-475 for a consideration of the interception of networked transmissions of data. ARPANET, primarily created for the support of research,is not to be confused with DOD's AUTODIN or NSA's AUTODIN component DIN/DSSCS. For some perspective, see "Datapast: Ten years ago", Computerworld, Aug 29, 1983, for a 1973 penetration of Tymnet by a teenager through his home computer.

While it may be argued that convergence of technologies indicates the maturity of those technologies (assuming common optimality), one very certain sign of the maturity of a marketplace is the entry of the corporate giants into the field. If this latter ascertain has any value, then the packet switching business is a mature one: recent months have seen the entry of ATT, IBM and Boeing into the marketplace.*

Maturity of the Packet Switching Marketplace: Entry of ATT and the Impact of Microcomputers on the Time Sharing Services

If the seventies was the decade of the maturing of the packet switching industry, the eighties will be the beginning of the broadening of the marketplace to the point that it will be transformed. Several technical issues must be addressed here as the basis for considering the entry of new corporate giants into the market. These technical issues are the success of the microcomputer, the growth of bibliographic utilities usage by end consumers of information and the (albeit hesitant) emergence of LAN/office automation systems creating complex multi-vendor environments which will require more embedded processing facilities in packet switching networks.

* In June 1979, GT&E acquired Telenet Communications Corporation. Such an acquisition is certainly a sign of the maturity of the market. In addition, this provides Telenet with a great increase in its ability to innovate and increase its market area.

Two of these innovations can be considered together: the explosion in microcomputer usage and growth of the access to bibliographic utilities.* The potential for the marketplace in packet switching to grow as a result of the expanded number of users is clearly a product of the microcomputer boom. Its impact on the industry is rather more uncertain. The principle impact is potentially a reduction of the proceesing work done by Tymshare, the parent firm for Tymnet. As the capabilities of local consumers to do their own processing grows, the volume of time shared services may fall. With Tymnet already suffering from capital shortfalls (something not now a problem at GT&E subsidiary Telenet which is planning; ironically Telenets expansion is more restrained since GT&E demands more short term profitability and eschews capitalization of Telenet at present), a decline in its main business may ill serve its network business.

The other technical consideration is more diffucult to define. The development of complex, decentralized, multi-vendor environments for real time data processing and data transmission pose a great opportunity for the packet switching industry. At the same time, there is considerable potential for diffuculties arising from the

* For a brief comment on the impact of the entry of IBM into the microcomputer market, see "PC compatible network", Computerworld, October 10, 1983, p.74; Cortino, J., "Tymshare develops packet switch net", Management Information Systems Week, Sept 21, 1983 (for PC oriented facility now only implemented in PC-DOS and in p-System DOS in 1984). Gillan, P., "T/S vendors must integrate micros, survey warns". Computerworld, Sept 12, 1983, p.16; Gillan, P., "Micro explosion forces T/S vendors to refocus", Computerworld, Sept 12, 1983, pp.1, 17 consider the general impact of micros. For end consumer use of PCs to access bibliographic utilities and databases, see Hewes, J. "Dialog: the ultimate on-line library", PC World, Sept 1983, pp.74-88.

same fact of environment complexity. While one response to this issue has been "embedded" processing such as Tymnet and Telenet electronic mail features and Net 1000's processing facilities, the final solution to such problems are probably to be found in a iterative process producing successive O/S designed for multi-vendor environments as well as for many micros/minis, such as UNIX.*

Both of these sets of technical changes in the data transmission and timesharing markets will affect the packet switching industry. As LAN/office automation and micro users become a greater part of the market for transmission services, more processing features will inevitably be embedded into the packet switching networks. And it is for this reason, I believe, that the appearence of the such giant firms as Boeing, IBM and ATT (now American Bell) can be explained.

In fact, it is precisely in terms of the potential for marketing embedded processing that seems to explain the policies embodied in American Bell's Net 1000. Renert, Net 1000 Director of Marketing

* See, for example, Rifkin, G., "UNIX spreads into the office", Computerworld, Office Automation, Oct 12, 1983, pp.60-66; and, "Nixdorf unwraps UNIX-compatible T/S for IBM", Computerworld, Sept 12, 1983, p.4.

states quite clearly that "programming and application is clearly one of the most important uses of the service".* Considering that Rehert spoke on "Integrating the Inside-Outside databases" at the Information Industry Meeting in San Francisco on Dec 12, 1982, it may not be farfetched to imagine database management as a major area of Net 1000's proceesing.**

Currently Net 1000 seems to have several major users working into their system, including Ford Motor Co's national automobile parts distribution/location/inventory operation.*** All these applications are to be written in COBOL by the users of the network.

Net 1000 structural will resemble Telenet, using both its more thoroughgoing (than Tymnet) distributed dynamic allocation system concept, as well as a full complement of Telenet's TP 4000's, the Telenet designed network switches. However, Net 1000 will offer transmission speeds of 56 Kbps: this compares with the common 9.6 Kbps (Boeing's Mainstream, Tymnet and Dun & Bradstreet), the slower 1.2Kbps by Comshare and the 19.2 Kbps offered by United Infor-

*Although one must state with some dismay that the language selected to be supported by NET 1000 is COBOL!, Johnson, op.cit, pp.142-143.

**While it is certainly arguable, I think that database management is both one of the most intractable theoretical and practical problems, and the most potentially rewarding (both in terms of social utility and profitwise) areas requiring attention.

*** Feldman, R. "AT&T says Net 1000 is flying now", MIS Week, Oct 19, 1983, pp. 1,17.

mation Services' Uninet. The packetizing will be preformed by front end VAXs.* Do note that much of this will change when and if the BPSS (Bell Packet Switching System) is approved by the FCC.

The Future of Packet Switching

The future is certainly filled with packets being switched. The question is not whether this industry will flourish, but rather what will the greater part of the enhancements to packet switching comprise. It seems very clear to that the great thrust in this field will be in embedding greater amounts of application packages into the mere transmission of packetized data. While the amounts of data that need to be moved will certainly grow quickly, it is value added features that the networks can support that must be the area of greatest potential growth.

Now, if only Net 1000 will lead the way by offering network supported LISP or PASCAL in fully intelligent environments...

*See Gillan, op.cit. pp. 16-18, Feldman, op.cit, p.17 for the relative transmission speeds and Johnson, op.cit, p.140, for the Net 1000 system design using dynamic allocation and Telenet TP 4000's. Ironically, one rich source for packet switching consumers will be those forced out of using convential telephone service as a result of the high tariffs to be placed on multipoint networks in the wake of the ATT breakup: the user response will be multiplexing and a retreat from telephone service to packet switching networks, "Multipoint users' rates to triple", MIS Week, Oct 19, 1983, pp.1,16.